



# Laboratory Methods and Academic Performance on Integrated Science in Schools in Rivers State

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## Abstract

The study investigated the impact of laboratory methods on students' academic performance in Integrated Science in Emohua Local Government Area of Rivers State. Quasi-experimental design was adopted for the study, specifically, the non-equivalent pre-test and post-test control group type. The sample for the study comprised of two hundred and ten (210) students drawn from the population of study using purposive-sampling technique. Two treatment groups were used for this study; group and individual laboratory works, which were also assigned to experimental group I & II with the treatments lasting for four weeks. The instrument for data collection in this study was a Integrated Science Achievement Test (ISAT). Data collected from the field work questions were analyzed using mean, standard deviation and Analysis of Covariance (ANOVA) to test the hypotheses at 0.05 level of significance. The results revealed that students taught Integrated Science using group laboratory activity performed better than their counterparts taught using individual laboratory activity. It was also revealed that male students had higher mean achievement scores than female students. In line with the findings of the study, the educational implications were highlighted and recommendations made which include among others that Integrated Science teachers should use group laboratory activity in teaching Integrated Science practical. Finally, the limitations of the study and recommendation were also given.

**Keywords:** Laboratory Method, Academic Performance, Integration Science.

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## INTRODUCTION

Integrated Science as a natural science subject which deals with contents from microscopic organisms to the biosphere in general, encompassing the earth's surface and all living things (Okwo & Tartiyus, 2014). Looking at the fundamental characteristics and importance of Integrated Science, it is currently viewed as a standard subject of instruction at all levels of our educational systems, from pre-primary to tertiary. It is the only core science subject at Junior School Certificate Examination (JSCE), whose study is very relevant to man's successful living (Akindele, 2010). Araoye (2010) opined that exposure to Integrated Science education offers learners a wide range of relevance to all aspects of life. The ideal behind Integrated Science as a course of study is to produce knowledgeable, highly motivated, professional and effective teachers of Integrated Science who will be able to develop in students, an appreciation and understanding of biological process and principles (NCCE, 2014).

Students' abysmal performance in Integrated Science examination has been linked to so many factors such as the availability of the needed teaching and learning resources and facilities. This performance can also be linked to the method of teaching. According to Ada (2012), teaching method is a mode of organization of the instructional content, materials, the manner of presentation to the learner and the activities that learners and teachers' carryout.

There are a number of methods of teaching which are available for the teacher's use in teaching Integrated Science. These methods are classified under two major groups; traditional and contemporary methods. The traditional method popularly called teacher- centered is where the teacher dominates the teaching and learning process, with examples such as Lecture method, demonstration method, and descriptive method among others. Contemporary teaching method is referred to as students-centered teaching approach, in this case students are actively involved in knowledge generation. Examples are Laboratory method, computer-based approach, concept mapping, and cooperative learning among others.

Researchers, Aniodoh, (2011), Babajide, (2010) Cengiz, (2010) have found out that students encounter some problems in laboratory works, such as lack of acquisition of desirable skills (poor observation of specimens, poor identification of specimens, drawing of specimens and poor recording or reporting of practical works). These problems make it difficult for students to understand laboratory practical work and theoretical knowledge acquired during classroom teaching and learning processes. In view of the above-mentioned problems faced by students in the laboratories, if the laboratory practical will be reorganized in a proper manner it will promote good teaching and learning processes in the classroom or laboratory. Hence, there is need for the development of appropriate approaches in the laboratory. Nakhleh & Krajcik, (2015) opined that investigative approaches used in carrying out experiments in the laboratory are based upon active learning, such as problem-based investigation, inquiry-based investigation, project- based investigation and cooperative investigations. In these approaches students interact with materials and with one another during laboratory practical work. According to Johnson and Johnson (2012) there are different types of interaction that take place in the classroom and laboratory such as cooperative, collaborative and competitive interactions but for the purpose of this study group and individual modes of interaction in laboratories will be investigated.

According to Joshi (2013), laboratory method of teaching is a unique way of instruction and it forms an integral part of effective science teaching. In this method, the teacher does not take recourse to lecturing nor to demonstration of experiment. Rather, the students are encouraged to derive the laws and principles of science themselves by actually performing the

experiments. The students are given all necessary materials and equipment's in the laboratory along with their proper instructions for carrying out their experiments with their own initiative and effort. The observations are recorded and the results are inferred. It helps the students to understand complex abstract ideas and gives students an opportunity to participate in the process and have an appreciation for the methods of science. He further viewed that knowledge and skills acquired through laboratory method is more lasting and permanent as they learn by their own experience, observation, testing and verification.

### **Aims**

- To examine the mean achievement scores of the students taught Integrated Science using Laboratory method of teaching and those taught using traditional teaching method.
- To examine the mean achievement scores of male and female students taught Integrated Science using laboratory teaching method.
- To investigate the difference in the performance, mean of retention scores of students taught Integrated Science using laboratory teaching method and those taught using traditional method.

### **METHODOLOGY**

Quasi-experimental research design is adopted for the study. Specifically, pre-test, post-test non-randomized control group design was used because the subjects were not randomized into group; intact classes could not allow randomization. The population comprised 0. 95 students, derived from public junior secondary school (JSS1 to JSS 3) integrated science students in the selected eight (8) schools in Emohua Local Government Area of Rivers State 2020/2021 session.

A sample of 210 students were used for the study derived from Taro Yamen. Purposive sampling method was mother used to select the respondents. The choice of purposive sampling technique was used given that the researcher intends to sample schools similar characteristics as a result eight junior secondary schools were drawn for the study. The questionnaire titled "Students Integrated Science Achievement Test" (SISAT) was developed and administered the respondents.

The student's Integration achieve test (SISAT) will contain forty (40) items requiring students to respond accordingly, which will be divided in to two parts, part A and B respectively. Part A contain general information and demographic data while part B will be used to gather information with regards the variables of the study.

The instrument will be used to estimate the reliability of the instrument using Kuder-Richardson formula (K-R 21) and an internal consistency reliability of 0.95 was obtained showing that the instrument to reliable for the study. The research questions were answered using descriptive statistics of mean and standard deviation, while the null hypotheses formulated will be tested using (ANCOVA) at 0.05 level of significant.

### **RESULT AND DISCUSSIONS**

**Research Question 1:** What is the mean achievement scores of the students taught Integrated Science using Laboratory method of teaching and those taught using traditional teaching method?

Table 1: Mean ( $X^2$ ) and Standard Deviation (SD) of student's achievement scores in Integrated Science

Mode of Lab. work	N	Pretest		Posttest		Gain score
		$X^2$	SD	$X^2$	SD	
Individual lab work (Experimental group 1)	106	15.24	3.26	20.02	3.15	4.78
Group lab work (Experimental group 11)	104	18.27	4.59	24.94	5.07	6.67

The data on students' achievement in table I revealed that students taught Integrated Science using individual laboratory activities had mean achievement score of 15.24 in pretest and 20.02 in posttest while their counterparts taught Integrated Science using the group laboratory activity had mean achievement score 18.27 in pretest and 24.94 in posttest. Students taught using individual laboratory activities had gain score of 4.78 while their counterparts taught using group laboratory activity had gain score of 6.67. Therefore, students taught Integrated Science using group laboratory activity performed better than their counterparts taught using individual laboratory activity.

**Research Question 2:** What is the mean achievement scores of male and female students taught Integrated Science using laboratory teaching method?

Table 2: Mean and Standard Deviation of male and female students' achievement scores in Integrated Science

Gender	N	Pretest		Posttest		Gain score
		$X^2$	SD	$X^2$	SD	
Male	103	16.44	4.10	22.90	4.93	6.46
Female	107	17.03	4.38	23.03	4.77	6.0

Result in Table 2 revealed that male students had mean achievement score of 16.44 in pretest and 22.90 in posttest, while the female students had mean achievement score of 17.03 in pretest and 23.03 in posttest. Male students had a gain score of 6.46 while their female counterparts had a gain score of 6.0 Therefore, male students had higher mean achievement score than their female counterparts.

**Research Question 3:** What are the mean retention scores of students taught Integrated Science using laboratory teaching method and students' gender?

Table 3: Mean and Standard Deviation of interaction effect of mode of laboratory activity and students' gender on mean achievement score of students in Integrated Science

Treatment	Group laboratory activities			Individual laboratory activities		
Condition	Pretest (Experimental I)			Posttest (Experimental II)		
Pretest	N	$X^2$	SD	N	$X^2$	SD

Male	43	17.89	4.68	60	15.40	3.29
Female	61	18.54	4.54	46	15.02	3.26
<b>Posttest</b>						
Male	43	26.33(8.44)	5.03	60	20.45(5.05)	3.25
Female	61	26.84(8.3)	4.94	46	20.22(5.2)	3.04
<b>Total</b>						
Observed mean		26.63	4.94		20.35	3.15
Gain score		8.36			5.11	

In table 3, it is observed that overall mean posttest score of students taught Integrated Science using group laboratory activities is 26.63 as opposed to 20.35 for students taught with individual laboratory activities. Therefore, students taught Integrated Science using group laboratory activities had higher mean score than those taught with individual laboratory activities. It is also seen in the same table that considering the main effect of gender, that female students have over all mean posttest scores of 23.99 higher than 22.90 for the males.

When the interaction of mode of laboratory activities and gender based on mean is considered, it is shown that male and female students differ in the mean posttest scores across the two modes of laboratory activities used. Thus, while females have higher mean scores using group laboratory activities than the males, the male student also have higher mean score using individual laboratory activities than their female counterparts. Thus, there is interaction effect of mode of laboratory activities and gender on mean post interest scores in Integrated Science.

Table 4: Analysis of Covariance of students' mean achievement score in Integrated Science

Sources of variation	Sum of square	Df.	Mean square	F	SIG.	DCS
Corrected model	3979.236	1	994.809	123.832	.000	Sig
Intercept	1265.476	1	1265.476	157.524	.000	Sig
Pre-test	1903.601	1	1903.601	236.956	.000	Sig
Method (treatment)	702.384	1	702.384	87.431	.000	Sig
Gender	.054	1	.054	.007	.935	Not Sig
Method x Gender	0.29	1	.029	.004	.952	Not Sig
Error	1646.878	205	8.034			
Total	121176.000	210				
Corrected total	5626.114	209				

R Squared = .707 (Adjusted R Squared = .702)

Data in table 4 showed that there is significant effect of method on students' achievement in Integrated Science  $f(1, 209) = 123.832, p < .000$ . The null hypothesis therefore was rejected because the significance is less than 0.05 indicating that there was significant difference in the mean achievement score of students taught Integrated Science using individual laboratory activities and those taught using group laboratory activities.

## Hypotheses Testing

**H0<sub>1</sub>:** There is no significant difference between the mean achievement scores of students taught Integrated Science using laboratory teaching method and those taught using traditional teaching methods.

**H0<sub>2</sub>:** There is no significant difference between the mean achievement scores of male and female students taught Integrated Science using laboratory teaching method.

Data in table 4 revealed no significant influence of gender on student's achievement Integrated Science  $f(1, 209) = .007, p > .000$ . The null hypothesis was rejected, because the significance is not above 0.05 indicating that there was significant difference in the mean achievement scores of male and female students taught Integrated Science using individual and group laboratory activities.

**H0<sub>3</sub>:** There is no significant difference between the mean retention scores of students taught Integrated Science using laboratory teaching method and gender.

Data in table 4 revealed no significant interaction effect of mode of laboratory activities and gender on students' mean achievement score in Integrated Science  $f(1, 209) = .004, p < .952$ . The null hypothesis was not rejected because the significance is above 0.05, indicating that there was no significant interaction effect of mode of laboratory activities and gender on students' mean achievement score in Integrated Science.

## **DISCUSSION OF FINDINGS**

Discussion of the findings of the study is presented under the following sub-headings:

- Effects of group and individual laboratory work on students' achievement in Integrated Science.
- Influence of gender on the mean achievement scores of students in Integrated Science when they are exposed to group or individual laboratory work/ interaction effect of gender and mode of laboratory activities on students' mean achievement score in Integrated Science.
- Interaction effects of laboratory activities and gender on students mean achievement score in Integrated Science.

### **Effects of group and individual laboratory work on students' achievement in Integrated Science**

Group laboratory activity was superior to individual laboratory activities in facilitating students' achievement in Integrated Science. This might be because the students working in groups were required to construct knowledge by cooperating with their colleagues and sharing ideas to construct knowledge, which made them to perform better than their counterparts who were taught using individual laboratory work. When students work in group to generate their own question, analyze and discuss their findings and finally organize their thoughts, they seem to understand their own information better than the ones the teachers introduced to them or the ones that they generate individually. The group laboratory activity was more effective because the

instructions were characterized by active student's involvement, thereby capturing the interest of the students and maximizing comprehension of the subject matter. This finding therefore is in line with the findings of Suleyman (2011), Afolabi & Akinyemi (2009), Cengiz (2010), Wachanga & Mwangi (2004) who found out that, students who work cooperatively perform better than their counterparts who work individually.

### **Influence of gender on the mean achievement scores of students in Integrated Science when they are exposed to group or individual laboratory work**

Result of the study on the influence of gender on the mean achievement scores of the students in Integrated Science showed that male students performed better than their female counterparts in individual laboratory work. This could be because of the different socialization processes of male and female persons in which the males are expected to explore their environment while the female is to conform or maintain their existing environment. The male students are allowed to play with toys and other forms of machines in the environment, which enables them to imbibe the culture of exploration, which the females are not always exposed to. The finding supports the finding of Nwagbo (1999), Awodi & Timothy (2001), Obiekwe (2008), Afolabi & Akinyemi (2009), Cengiz (2010) & Suleyman (2011) who found out in their respective studies that male students perform better than their female counterpart in science subjects. Contrary to this finding, studies carried out by Abiodun (2004); Okoh, Iwuozor & Obioma (2011); Ukozor (2011); & Nwosu (2011) maintained that gender has significant difference in academic achievement in science.

### **Interaction effects of laboratory activities and gender on students mean achievement score in Integrated Science**

On interaction effect of laboratory activities and gender on mean achievement score, the finding of this study showed that there was no significant interaction effect of laboratory activities and gender on students' mean achievement scores in Integrated Science. This is because the difference in their performance was not significant. However, the performance of the male students was slightly higher than that of their female counterparts, even though it was not statistically significant. This slight difference in the performance of male students and their female counterparts could be as a result of the nature of instructions delivered to the students, which enabled both the male and female students to be actively involved during the teaching and learning process. However, the male students performed better than their female counterparts, even though it was not statistically significant. This difference in the score of male students and their female counterparts could be as a result of the student's disposition to learn, both male and female students had equal opportunity to participate actively, but maybe the male students were more determined to learn than their female counterparts. Though the female students made considerably good effort based on their results.

## **CONCLUSION**

From the results obtained in the study on the effects of modes of laboratory activities on students' achievement in Integrated Science, it was found out that:

Students taught Integrated Science using group laboratory activity performed better than their counterparts, taught Integrated Science using individual laboratory activity. Male students performed better than their female counterparts in Integrated Science achievement test but that was due to chance factors as the difference was not statistically significant.

There was no significant interaction effect of mode of laboratory activities and gender on students' mean achievement score in Integrated Science. Furthermore, the findings of the study showed that male performed better than their female counterparts in Integrated Science practical. The implication of this finding is that most instructional approach used in teaching Integrated Science does take care of gender difference in students. Therefore, gender has to be considered during instructional delivery so that both male and female students will have equal opportunity to learn. The findings of this study also have implication to curriculum planners, they should include group laboratory activity in future curriculum designing and redesigning.

## Recommendations

Based on the findings of this study the following recommendations are made:

- Integrated Science teachers should be trained on how best to involve students into group laboratory activity during Integrated Science practical instructions so as to facilitate students' achievement in the lesson. This could be achieved through seminars and workshops for teachers in secondary schools.
- Teachers should make teaching and learning of Integrated Science gender friendly.
- The curriculum planners should ensure that they laboratory activity approach in Integrated Science curriculum, as it will help to promote students' achievement in the subject.
- In view of the fact that group laboratory activity was more effective in enhancing student's achievement in Integrated Science practical than individual laboratory activity, the Ministries of Education should ensure that textbook authors should incorporate group laboratory activity in the instructional methods for junior secondary schools Integrated Science practical

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